Science Education International
Vol. 17, No. 3, September 2006, pp. 171-186

International Council of Associations in Science Education

Science Education Ideas, Practices and Needs of Pre-Primary School Teachers in Greece

GEORGE BAGAKIS (gbag@otenet.gr), GEORGIA BALASKA (gbalaska@yahoo.gr), VASSILIS KOMIS (komis@upatras.gr), KONSTANTINOS RAVANIS (ravanis@upatras.gr)

ABSTRACT *The present article presents the results obtained from a research on Science Education ideas, practices, and needs of pre-primary teachers in Greece. A questionnaire was administrated to a sample of 130 pre-primary school teachers, and the data was analyzed through Multiple Correspondence Analysis. The results show that there are separate groups of teachers, whose ideas and science teaching activities are related to their age, previous teaching experience, and studies.*

KEY WORDS: *Pre-primary teachers, science education*

Introduction

In recent years, only few studies relating to learning and teaching science in pre-primary education appeared in the international literature (Ravanis, Koliopoulos & Hadzigegorgiou, 2004; Robbins, 2005; Valanides, Gritsi, Kampeza, & Ravanis, 2000; Zogza & Papamichael, 2000). In these studies, teachers delve into their own reality, note down their problems and difficulties, consider and judge their practices, and, on the basis of their findings, plan the improvement of their teaching. Researchers could only play the role of facilitators or critical friends supporting teachers' initiatives to deal with their problems (Bagakis, 1994). Researchers also tend to use research techniques, such as the interview and questionnaires, to figure out the elements of teachers' problems, while teachers become themselves the subjects of research (Tsitouridou, 1999).

These activities provide information and useful insights related to pre-primary school teachers and their difficulties in teaching science. Some findings relate to pre-primary school teachers' attitudes, ideas, knowledge, practices, and their pre- and in-service education. Evidence indicates that pre-primary school teachers believe that these attempts do not provide adequate information and sufficient knowledge for designing effective science activities (Harty, Andersen, & Enochs 1984; Newton & Newton, 2001; Raper & Stringer 1987). Research results suggest however that knowledge transformation in the science teaching "appears as a necessary precondition for the possibility of intervention and support of the curriculum through processes extending the abilities of the children and the critical view of scientific knowledge" (Tsitouridou, 1999, p. 92).

Pre-primary school teachers sometimes express a sense of insecurity and doubt, as to whether they are able to effectively support such activities (Appleton, 1995;

Young & Kellong, 1993). This sense of incompetence is in many cases the source of negative attitudes and unwillingness to show initiative in the direction of science teaching (Lucas & Dooley, 1982; Raizen & Michelsohn, 1991). But, it has been recognized that pre-primary school teachers not only show an increased interest in performing science activities, but that they also change their attitudes and become willing to work towards this direction, after they have participated in relevant training seminars (Abell & Roth, 1998; Koliopoulos, 2003). Despite the positive change in attitudes and the acquisition of the relevant knowledge, there are still additional difficulties in developing new educational practices in science. These difficulties relate to a variety of factors, such as teachers' expectations, previous social experience relating to science teaching, support, encouragement and confidence embedded in the school environment (Mellado, Blanco, & Ruiz, 1998; Skamp, 1991)

The present study attempted to investigate the general characteristics of ideas, practices, and needs of Greek pre-primary school teachers regarding the design and implementation of teaching activities targeting the development of science concepts in pre-primary classes, and other variables relating to their educational, professional, and personal profile.

Methodology

Setting of the Study

The research was carried out using a questionnaire that consisted of 19 questions (15 close-ended and 4 open-ended questions). The questions asked pre-primary teachers to provide demographic information, such as their age, previous teaching experience, studies, and professional status, information about the science courses they completed during their pre-service education, their confidence in performing science-related activities, the materials and equipment they usually use at their work in a kindergarten, and their ideas about the adequacy of science-related activities in the curriculum. Other questions concerned the way pre-primary teachers are engaged in science-related activities, performance techniques, materials, and the time needed to complete the activities. Finally, there were questions seeking information about the kind of conferences, seminars, or workshops that they attended, their evaluation of these activities, and the kind of training that they considered more interesting, productive, or influential.

Sample

The sample consisted of 140 female pre-primary school teachers, who volunteered to anonymously answer a questionnaire, but only 130 of them completed the questionnaire. The final sample consisted of teachers permanently employed and teachers working with an annual contract in the public educational system. In terms of pre-service education, the sample included three main groups of pre-primary teachers. One group consisted of those who had a university degree in pre-primary education (four-year university program), another group included those who completed a two-year program from teacher training institutions, and the third group included those who graduated from teacher training institutions, but attended for two more years a department of education in order to complete their studies and receive a university degree in pre-primary education.

Research Questions and Tools of Analysis

The structure of teachers' needs and ideas cannot be revealed through conventional statistical methods, like descriptive statistics. The *Multiple Correspondence Analysis* (MCA) (Benzécri, 1992; Greenacre, 1993) was used for analyzing the data. This method was employed, because the descriptive statistical analysis of the teachers' responses to the questionnaires can only illustrate their central tendencies in terms of each question. To surmount this limitation, *Multiple Correspondence Analysis* was used to analyze the data. In the social sciences, the main application of MCA is to visualize the interrelationships between response categories of a set of questions in a questionnaire. The method allows the visualization of the relationships between the different questions (variables) in a spatial map and the interpretation of the identified relationships, but, in addition, allows the display of explanatory variables, such as age, education, and gender in order to enrich the interpretation (Greenacre, 1993).

MCA targeted a deeper investigation of teachers' ideas, practices, and needs concerning science teaching, and addressed the following questions:

1. How are teachers grouped according to their opinions and ideas about science activities?
2. How are teachers' practices set up and defined with respect to their profile?
3. How are teachers' training needs set up and what do they depend on?

We employed our analysis using the software SPAD version 5. We applied the CORMU (Correspondences Multiples) method, which is equivalent to the HOMALS (Homogeneity Analysis) procedure of SPSS version 11. Therefore, such an analysis provides information about the way certain views-ideas, practices and training needs, resulting from pre-primary school teachers' answers to different consecutive questions of similar content, are shaped. Relations among the questions are broadly defined by the conceptual framework of the research and the questions addressed. The questions of a questionnaire are grouped, so that the appropriate categories relating to the research questions can be determined. The grouped categories are mentioned below.

The first big group of questions (8 questions) consisted of two subgroups, according to the profiles of the teachers:

1. ***Social Profile***: Age, studies, previous teaching experience, and professional status of pre-primary school teachers (questions 1-4).
2. ***Educational Profile*** (courses in Sciences) and ***professional potential*** (school facilities) of pre-primary teachers (questions 5, 7-9).

These categories were then considered the independent variables of the analysis. Within this framework, they were considered explicative variables that determine the ideas of pre-primary teachers about the curriculum of natural ciences in the pre-premiray schhol, their confidence as regards the performance of science activities, correlative practices, and training needs with respect to natural sciences, as they were defined by pre-primary teachers themselves.

The second group of questions (8 questions) consisted of three subgroups, which were related to the main axes of our research directions and the related conceptual framework. These subgroups concerned the ideas, practices, and training

needs of the research participants:

1. ***Views*** (***ideas***) on the ***curriculum*** related to natural sciences and teachers' ***confidence*** as regards the performance of science activities (questions 6, 10, and 11).
2. ***Practices*** of pre-primary teachers with respect to natural sciences, as they resulted from both the answers to the questionnaire and the qualitative classification made for some of the respective questions (14 and 16).
3. ***Training Needs*** of pre-primary teachers with respect to natural sciences, as they resulted from the analysis of the answers to the respective questions of the questionnaire (17, 18, and 19).

We then proceeded with three multiple correspondence analyses, where the two groups of questions comprising the social and educational profile of teachers were the explanatory variables (status variables), and the three groups of questions describing the attitudes, practices and needs of pre-primary teachers were the variables to be explained (opinion variables). Three open-ended questions, concerning the time needed to complete the activities and the science education concepts used, or desired to use during their teaching, were not included in our analysis.

We chose this kind of multivariate analysis (MCA), because it helped us obtain an overall view of the pre-primary school teachers' ideas and practices and revealed numerous correlations across the research questions in conjunction with age, experience, professional status, studies and other characteristics (existence and type of materials, science teaching corner, duration of activities).

Statistical multivariate analysis methods evolved significantly during the last ten years, while their applications expanded in various domains (Benzécri, 1992; Gifi, 1990) including educational research studies (Marcoulides & Herhberger, 1997; Tacq, 1997). They constitute tools suitable to explore relationships between variables, especially when research data concern simultaneous measurements of many parameters (Jonson & Wichern, 1998). There are many methods of multivariate analysis, which primarily differ in the data sorting techniques they use. *Multiple Correspondence Analysis (MCA)* is a well established multivariate technique allowing to analyse and describe graphically and synthetically a large amount of research data (Benzécri, 1992). It offers effective tools that can help us overcome the intrinsic limitations of descriptive statistics: the subjects under study are usually described by a large number of parameters (represented as statistical variables), and the MCA method permits to detect structure in the relationships between these variables. This method is also known as Homogeneity Analysis (Gifi, 1990) and Dual Scaling (Nishisato, 1980). It aims at the graphical representation of the structure of non-numerical multivariate data (questionnaires, etc.). The fundamental principle of the MCA method is that complex multivariate data can be interpreted by displaying their main regularities and patterns in graphs and diagrams.

Given that the subjects have been voluntary selected from all public pre-primary schools of Patras, and the intrinsic characteristics of MCA (MCA is not an inferential method), results cannot be generalized and valid rules about the population from which the sample was drawn cannot be determined. Thus, MCA is an exploratory technique that deals mainly with the structure concerning the needs

and ideas of the participants under study.

The method of MCA was aligned with the principle that emphasises the development of models that fit the data rather than the rejection of hypotheses based on the lack of fit (Benzécri, 1992; Greenacre, 1984). Contrary to conventional inferential statistical methods, no technical assumptions are posed in MCA (Lebart, Morineau, & Pitron, 1998), and MCA can be applied to data analysis without the necessity to check any assumptions concerning the relevant data. The detailed relationship between the values of the numerous variables that characterise the participants has a qualitative form that allows the construction of valid assumptions offered for further study and analysis.

Data Analysis and Findings

Views/Ideas about the Curriculum of Sciences and the Confidence of Pre-primary Teachers

This section studies the way pre-primary teachers form their ideas about the part of the curriculum relating to natural sciences and their confidence in terms of their performance on science activities. In the Multiple Correspondence Analysis (Benzécri, 1992; Greenacre, 1993), questions 6, 10 and 11 were used as dependent variables and the questions concerning the teachers' profiles (1 – 5 and 7 – 9) as independent variables.

Table 1
MCA Parameter Values Concerning Teachers' Ideas

Factor	Eigenvalue	Coefficient of Inertia	Cumulative Percentage (%)
1	0.6025	30.13	30.13
2	0.5671	28.35	58.48
3	0.3336	16.68	75.16
4	0.3143	15.72	90.88
5	0.1113	5.56	96.44
6	0.0712	3.56	100.00

The horizontal axis of the analysis (factor 1) shows the 30.13% of the overall inertia, that is, the full information from the analysis, which is a very high percentage for this kind of analysis, as indicated in Table 1. The positive side of the horizontal axis in Figure 1 shows the negative values of questions 10 and 11. In particular, it shows the answers that state that there are not enough science activities in the curriculum and that these activities are not well developed. The negative side of the horizontal axis shows the missing values of these questions, which, to a great extent, represent subjects unable to give an answer and, as a result, teachers without any clear ideas about similar issues. This axis bears the ideas of teachers who were not satisfied with science activities in the pre-primary curriculum, and the ideas of teachers who did not express their opinion.

The vertical axis of the analysis (factor 2) shows the 28.35% of the overall inertia, that is, the full information from this analysis, as indicated in Table 2. On the positive side of the vertical axis in Figure 1, the missing values of the two questions

related to the curriculum of natural sciences, appear again, while, on the negative side, of the vertical axis, the positive answers to the same questions appear. As a result, this axis is described by the contrast between the positive ideas about the curriculum and the absence of any clear ideas.

The factorial plane defined by the first two axes in Figure 1 provides additional information about the ideas of pre-primary school teachers concerning their social and educational profile. On this plane, three separate groups, resulting from the values of the dependent variables, are observed, that is, the variables that express the pre-primary school teachers' ideas about the three questions of the present study

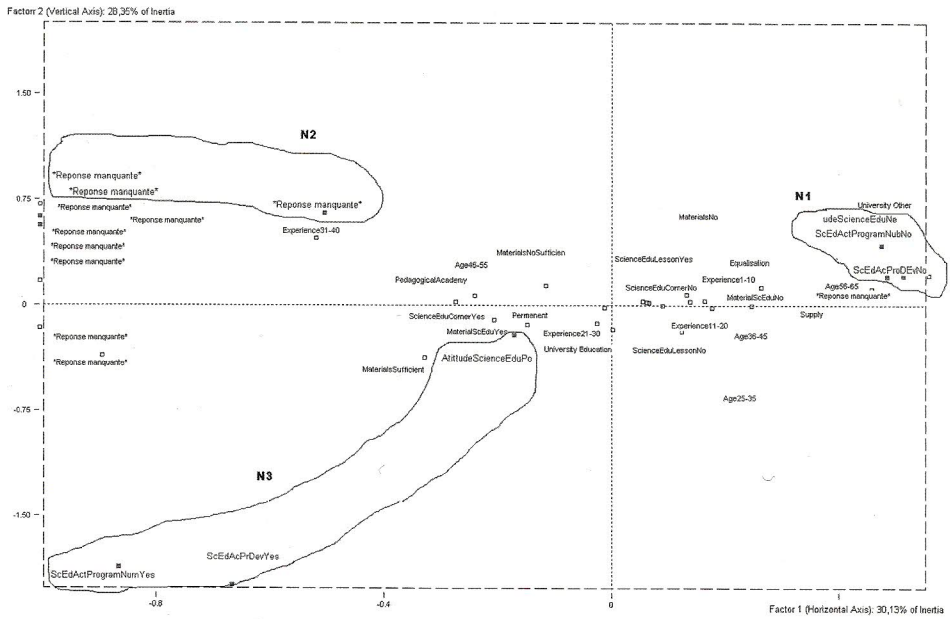


Figure 1. Graphical Representation of Pre-primary School Teachers' Ideas on the Factorial Plane Defined by the First Two Factors Axes

The first group (cloud N1) consists of the negative ideas about the kindergarden curriculum of natural sciences as well as the inability of pre-primary teachers to deal with similar activities in the classroom. It is the group that includes most of the research participants. The second group (cloud N2) consists of the missing values of the three questions of the present analysis, that is, pre-primary school teachers who did not seem to form any ideas about these issues. The third group (cloud N3) consists of the positive ideas about the pre-primary curriculum of natural sciences and the opportunity for similar activities to take place in the classroom, as this was expressed through positive confidence.

The existence of three separate groups highlights the incidence of the Guttmann phenomenon that shows a strong correlation among the subgroups formed by the values of the variables.of the analysis. In other words, there are three tightly formed groups of pre-primary school teachers in terms of their ideas.

In the framework of the analysis, the factorial plane also shows the values of

independent variables related to pre-primary school teachers' profiles. Interesting results stem from this fact in terms of the the characteristics of the three groups defined by this analysis. Near the first group, there are mainly young teachers with a little or some experience (less than 20 years), who had neither a natural sciences corner at school nor materials for practical activities in science education. The same group includes the majority of pre-primary teachers under contract as well as the graduates of Pedagogical Academies, who later completed their training in University Departments. The group that does not express any specific ideas and attitudes (missing values) comprises the majority of teachers with long experience in education, that is, those who just graduated from Pedagogical Academies as well as those who believed that they did not have enough materials for practical activities in science teaching in the pre-primary school.

The group of participants having positive ideas and attitudes includes the majority of teachers who graduated from University Departments of Early Childhood Education, had some professional experience, worked regularly, had a science teaching corner in the classroom, and believed that they had enough materials for practical activities in science education. Finally, it should be noted that any science education courses the teachers took during their studies did not appear to greatly affect their ideas.

Science Practices of Pre-primary Teachers

This section presents pre-primary school teachers' practices with respect to science activities. Multiple Correspondence Analysis was again used, while questions 12 – 16 related to teachers' practices (as described by the teachers themselves in the questionnaire), were used as the dependent variables and the questions about the teachers' profiles (1-5, 7-9) as independent variables.

Table 2
MCA Parameter Values Concerning Teachers' Practices

Factor	Eigenvalue	Coefficient of Inertia	Cumulative Percentage (%)
1	0.7179	25.64	25.64
2	0.2921	10.43	36.07
3	0.2634	9.41	45.48
4	0.2264	8.08	53.56
5	0.2185	7.80	61.36
6	0.1963	7.01	68.37
7	0.1838	6.56	74.94
8	0.1677	5.99	80.93
9	0.1624	5.80	86.73
10	0.1505	5.38	92.10
11	0.1000	3.57	95.68
12	0.0786	2.81	98.48
13	0.0302	1.08	99.56
14	0.0123	0.44	100.00

The horizontal axis of the analysis (factor 1) describes the 25.64% of the overall inertia, that is, the full information from the analysis, which is also a very high

percentage for this kind of analysis, as shown in Table 2. It is the axis that records the existence or absence of practices with respect to natural sciences in the pre-primary level. On its positive side in Figure 2, the axis bears the values of variables with respect to teachers who did not deal with science teaching or did not answer (missing values) the questions concerning the kind of activities, the connection of activities with the curriculum, and the time they spent in the activities. It represents the group of teachers who did not perform any science activities. Although the number of teachers answering along these lines was low (ranging from 7 to 18 out of a total of 130 pre-primary school teachers), they seemed to represent a tightly formed group.

The negative side of the axis shows the values of variables corresponding to the research samples who dealt with teaching activities concerning natural sciences, used mainly everyday objects to perform the activities, performed activities outside the curriculum, and used both demonstrations and experiments as teaching methods, while the time they spent in each activity ranged from 16 to 20 minutes. There was obviously a clearly defined group of pre-primary school teachers, who developed science activities with specific characteristics.

The vertical axis of the analysis (factor 2) shows the 10.43% of the overall inertia, as indicated in Table 2. This axis provides additional information about the practices of the research participants, since it mainly included variable values that were not included on the first axis. The positive side of the axis in Figure 2 bears the highest values of this analysis. On the one side, there were answers of pre-primary teachers who did not perform any science activities or only performed activities using simple demonstrations, that represent the weakest kind of practice in science teaching. On the other side, there were answers of teachers who performed science activities outside the curriculum and used not only everyday materials, but also specific technical objects or equipment in their activities, which means that they employed more advanced practices in science teaching. On the negative side of the axis in Figure 2, the answers related to the use of everyday objects for performing science education activities, activities related or not related to the curriculum, teaching methods that used both experiments and demonstrations, and, finally, the duration of the relevant activities.

The factorial plane defined by the first two axes in Figure 2 gives additional information about the practices of pre-primary teachers with respect to their social and educational profile. The projection of both the above values and the values representing the profiles of the participating teachers on the factorial plane defined by the first two axes gives important details about the resulting groups. The groups express the individual practices of the pre-primary teachers of the research with respect to natural sciences in the pre-primary school, and are interpreted based on the strength of the social and educational profile of pre-primary teachers.

However, the factorial plane in Figure 2 includes four separate groups distributed on the four quarters of the plane. The first group (cloud N1) includes the missing values of the questions concerning the existence of science activities, type of materials, teaching methods used (demonstration or experiment), and duration of activities. Consequently, this relates to the teachers who did not express their ideas about the questions concerning science practices. The first conclusion drawn

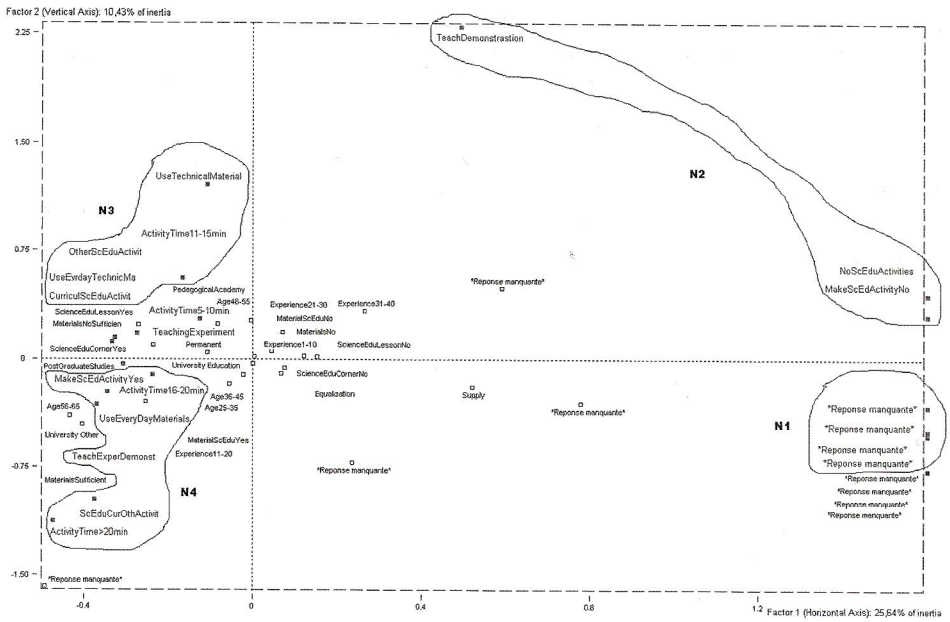


Figure 2. Graphical Representation of Pre-primary School Teachers' Practices on the Factorial Plane Defined by the First Two Factor Axes

from this group is that the teachers, who did not answer one question, did not answer, as a rule, the rest of the questions as well. This indicates a common attitude towards science practices. This group included a small number of subjects (that is why the values are far from the beginning of axes), which did not deal at all with natural sciences in the pre-primary school. The projection of the variables' values concerning the profiles of the participating teachers on the factorial plane indicates that close to this group (in the same quarter), there are mainly pre-primary teachers working under contract, but the majority consists of those who have graduated from the former two-year Pedagogical Academies and later completed their studies with two more years (2+2) attending special educational courses in a university Department of Early Childhood Education. These teachers did not have a sciences corner in their classrooms.

The second group (cloud N2), which is relatively close to the previous group, includes the teachers who either did not deal with natural sciences and clearly stated so or, when they were dealing with natural sciences, their teaching methods involved the demonstration of various materials and processes, and not the performance of experimental activities carried out by the teacher or the students. The profile of this small group of teachers indicates that the majority consists of teachers with a long teaching service (20 to 40 years) or very short previous service (1 to 10 years), who did not take courses in natural sciences during their studies, and neither had, nor used materials for science activities.

The third group (cloud N3) consists of teachers who adopted specific practices in natural sciences. There were many teachers (here the values are close to the beginning of axes), who used specialised materials beyond everyday objects for performing science activities, despite their expressed beliefs that they did not have

enough materials for such activities. These activities were carried out mainly outside the curriculum, at a special science corner and did not last long enough (11 to 15 minutes). The majority of teachers in this group attended relevant science methods courses during their studies, worked normally in public schools, were relatively old (46 to 55 years old) and graduated from a Pedagogical Academy.

The fourth group (cloud N4) consists of the teachers who used the most advanced practices in performing science activities. There were many teachers in this group as well (the values are close to the beginning of axes) and the group included the teachers who clearly stated that they performed science activities, spent considerable time in science activities (16 to 20 minutes or more than 20 minutes), usually used everyday materials, performed activities related to the curriculum and outside the curriculum, while they used both demonstrations and experiments as teaching strategies. This group consists mainly of graduates from University Departments of Early Childhood Education, who were relatively young (25 to 45 years old), had moderate educational experience (11 to 20 years), and considered their materials sufficient for science activities.

Training Needs of Teachers of Natural Sciences

This section investigates the training needs of pre-primary teachers with respect to natural sciences in connection with their social and educational profile. Multiple Correspondence Analysis, where questions 17, 18, and 19 referring to the training needs of pre-primary teachers (as they reported them) were used as dependent variables and questions 1-5 and 7-9 concerning pre-primary teachers' profiles were used as independent variables.

Table 3

MCA Parameter Values Concerning Teachers' Training Needs

Factor	Eigenvalue	Coefficient of Inertia	Cumulative Percentage (%)
1	0.5840	25.03	25.03
2	0.3968	17.01	42.04
3	0.3587	15.37	57.41
4	0.3332	14.28	71.69
5	0.3083	13.21	84.90
6	0.2135	9.15	94.06
7	0.1387	5.94	100.00

The horizontal axis of the analysis (factor 1) represents the 25.03% of the overall information of the analysis as shown in Table 3, and is related to questions 17 and 18, which inquired both the participation of teachers in congresses or seminars relating to natural sciences and their relevant training. The negative side of the axis bears the values that express gaps in natural sciences knowledge, the general need for training and the specific need for laboratory training, while the positive side of the axis bears the missing values, as indicated in Figure 3. This is the axis that expresses gaps and the need for more training in science teaching.

The second axis (factor 2 does not appear on the factorial plane of Figure 3)

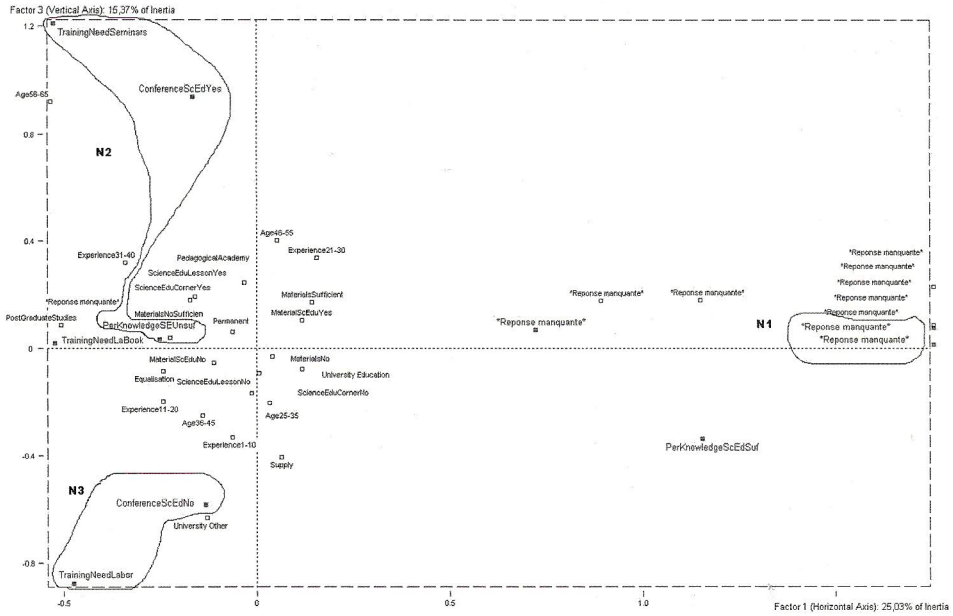


Figure 3. Graphical Representation of Teachers' Training Needs on the Factorial Plane Defined by the First and the Third Factor Axes

represents the 17.01% of the overall information resulting from the analysis, as shown in Table 3, relating to almost the same issues. Its negative side indicates the values that revealed gaps in science knowledge, as it happens in the first axis, and the missing values in question 18 (competence in training), while its positive side shows competence in science knowledge and the missing values in question 19 (satisfactory training).

Because the second axis gives almost the same information as the first axis, the third axis (factor 3), representing the 15.37% of the overall analysis information (Table 3), is used as the vertical axis of the factorial plane. This axis provides additional information about the values of the variables that has not been provided by the two previous axes. On the positive side of this axis, the theoretical needs for supporting pre-primary teachers' work, such as their expressed needs for additional training and participation in science education conferences, are in opposition on the negative side to the practical needs for laboratory training as well as the limited interest in participating in science conferences, as indicated in Figure 3. As a result, this is the axis that provides information about the kind of the desired training in science teaching.

The factorial plane defined by the first axis and the third axis offers interesting results concerning the way pre-primary teachers are grouped with respect to their training needs, as indicated in Figure 3. On this plane, the values of variables concerning the profile of teachers also appear. In this way, the ideas of the teachers about the needs and the kind of their training will be associated with their social and educational characteristics.

On the factorial plane (Figure 3), there are three separate groups distributed on the first three quarters of the plane. The first group (cloud N1) consists of the

missing values in questions 17 and 18 (congresses or seminars on science teaching and relevant training). It is a small group, whose members did not express their ideas about the needs for training in natural sciences. Close to this group are mainly older pre-primary teachers having long professional experience and teachers who thought that they had adequate materials for performing science activities.

The second group (cloud N2) consists of those teachers who expressed the need for seminar training, participation in congresses or seminars and the belief that these teachers did not have adequate knowledge in the natural sciences. This group mainly comprises teachers who graduated from a Pedagogical Academy, had relatively long teaching experience, took courses in natural sciences during their studies, worked regularly, and had a science teaching corner in their classrooms. This group expressed that they had training needs of a more theoretical character.

The third group (cloud N3) consists of the teachers who expressed the need for training in the form of more laboratory processes and experiments, as well as the teachers who did not participate in any congresses. This group comprises mainly teachers with little or moderate teaching experience that graduated from the former Pedagogical Academies and completed their studies in University Departments. They hade never taken courses in natural sciences and did not have relevant materials in class. It is a group that mainly expressed training needs of a practical character.

Discussion

The analysis seems to lead to interesting results concerning the way the ideas of pre-primary teachers are formed, their relevant practices, and the way their training needs are expressed. Indeed, it seems that both the ideas and the training needs depend on and are related to the social profile of the teachers, as this is defined by their age, studies, teaching experience and professional status, training in Sciences, as well as the facilities and prospects of the school they work in.

First of all, there are groups of teachers who do not principally deal with teaching activities in Sciences. In general, these teachers perform limited activities as regards quality and quantity, are not satisfied with the part of the curriculum related to Sciences, and think they are not able to display more initiative. In their classrooms there are neither Science teaching corners, nor the appropriate educational materials. During their studies, mainly in Pedagogical Academies, with or without further studies in the Departments of Early Childhood Education, they were never taught subjects on Sciences, while their ages and experience range widely. The teachers who do not answer the questions about their ideas and practices have almost the same characteristics.

These results are similar to the results from researches relating teachers' attitudes and practices to Science knowledge (Newton & Newton, 2001; Tsitouridou, 1999). Our research data showed that these pre-primary teachers have never taken Science or Science Education courses before. This seems to be related to the fact that they do not use any educational materials to develop relevant activities, but also to the fact that they are ill-disposed toward both the science part of the curriculum and their own capabilities. It would be of particular interest to deal with these difficulties through planning and running special educational courses that

would combine Science and Science Education within the framework of pre-primary education.

On the other hand, there are groups of teachers that display considerable initiative in performing activities in Sciences, have a Science education corner in their classrooms, and adequate educational materials. They took Science courses during their studies, but they do not consider them useful. Among them, some are young with less teaching experience, some work regularly, and some are under contract; they usually graduated from Departments of Early Childhood Education and are extremely confident. These teachers are satisfied with the curriculum although they often go beyond it and work with everyday materials in order to develop quite long activities. It is useful to point out the particular importance of the basic studies of younger pre-primary teachers in the Departments of Early Childhood Education (Abell & Roth, 1998; Koliopoulos, 2003). This group has attended special courses in Science and Science Education and seem to be ready to deal with everyday problems in the kindergarden in different ways.

Another fairly big group consists of teachers who work regularly, are older, have longer teaching experience, and perform short activities with the help of special technical materials, because they seem to consider Sciences an absolutely specialised practice (Tsatsaroni, Ravanis, & Falaga, 2003).

As for the training needs expressed by the teachers, the findings are quite interesting. First of all, only those who graduated from Pedagogical Academies have systematic ideas. Any of them who took Sciences courses systematically perform Sciences activities in the Sciences education corner, have a fairly long experience, feel unconfident, and are interested in some theoretical ideas and modern approaches presented in special congresses. Other teachers with less experience and without participation in Sciences courses –despite the two additional years of studies at the Universities– are more interested in being trained in practical activities, because it seems that the lack of the relevant skills causes difficulties in their job.

Finally, we should highlight that several categories include lots of answers to ideas about the training of young and inexperienced teachers that graduated from University Departments. This means that those teachers have not fully realized their training needs yet.

The present research tried to shed light on some aspects of the relation of pre-primary teachers with matters concerning the development of Sciences activities in the kindergarden. In particular, we approached questions related to the curriculum, some teaching practices as well as the way the teachers perceive their training needs in relation to some interesting variables. The approach helped us detect groups of teachers with special characteristics as regards our research questions which, although offered us quite clear and processed pictures of their general orientations, remained general due to the nature of the research technique used. On the strength of these findings, a more detailed approach to the matters we dealt with requires the use of techniques, such as the interview, or methods, such as action research. We have already put in a great deal of effort in this direction.

REFERENCES

ABELL, S. K., & ROTH, M. (1994). Constructing science teaching in the elementary school: The socialization of a science enthusiast student teacher. *Journal of Research in Science Teaching, 31(1),* 77-90.

APPLETON, K. (1995). Student teachers' confidence to tech science: Is more science knowledge necessary to improve self-confidence? *International Journal of Science Education, 19(3),* 358-369.

BAGAKIS, G. (1994). Towards a teachers' epistemology in science education: the appearance of action research. In M. Laidlaw, P. Lomax & J. Whitehead (Eds), *Proceedings of World Congress 3 on action research and process management* (5-8). Bath: University of Bath.

BENZECRI, J. P. (1992). *Correspondence Analysis Handbook.* New York: Marcel Dekker.

GIFI, A. (1990). *Nonlinear multivariate analysis.* New York: John Wiley & Sons.

GREENACRE, M. J. (1984). *Theory and applications of correspondence analysis.* London: Academic Press.

GREENACRE, M. J. (1993). *Correspondence analysis in practice.* London: Academic Press.

HARTY H., ANDERSEN, H., & ENOCHS, L. (1984). Science teaching attitudes and class control ideologies of pre-service elementary teachers with and without early field experience. *Science Education, 68(1),* 53-59.

JIMOYIANNIS, A., & KOMIS, V. (2001). Computer simulations in physics teaching and learning: A case study on students' understanding of trajectory motion. *Computers & Education, 36(2),* 183–204.

JONSON, R., & WICHERN, D. (1998). *Applied multivariate statistical analysis* (4th ed.). New Jersey: Prentice Hall.

KOLIOPOULOS, D. (2003). Preschool teachers training in Sciences. In M. Tsitouridou (Ed), Sciences and New Technologies in pre-primary education (33-44). Thessaloniki: Tziolas (in Greek).

LEBART, L., MORINEAU, A., & PITRON, M. (1998). *Statistique exploratoire multidimensionnelle.* Paris: Dunod Editeur.

LUCAS K., & DOOLEY, J. (1982). Student teachers' attitudes toward science and science teaching. *Journal of Research in Science Teaching, 19(9),* 805-809.

MARCOULIDES, G., & HERHBERGER, S. (1997). *Multivariate statistical methods. A first course.* Mahwah, NJ: Lawrence Erlbaum Associates.

MELLADO, V., BLANCO, L., & RUIZ, K. (1998). A Framework for learning to teach Science in initial primary teacher education, *Journal of Science Teacher Education, 9(3),* 195-219.

NEWTON, D., & NEWTON, L. (2001). Subject content knowledge and teacher talk in the primary science classroom. *European Journal of Teacher Education, 24(3),* 369-379.

NISHISATO, S. (1980). *Analysis of categorical data: Dual scaling and its applications.* Toronto, Canada: University of Toronto Press.

RAIZEN, S. A., & MICHELSOHN, A.M. (1994). *The future of science in elementary schools.* San Francisco: Jossey-Bass.

RAPEN G., & STRINGER J. (1987). *Encouraging Primary Science.* London: Cassel Publishers Ltd.

RAVANIS, K., KOLIOPOULOS, D., & HADZIGEORGIOU, Y. (2004). What factors does friction depend on? A socio-cognitive teaching intervention with young children. *International Journal of Science Education, 26,* 997-1007.

ROBBINS, J. (2005). Brown Paper Packages'? A Sociocultural Perspective on Young Children's Ideas in Science. *Research in Science Education, 35(2/3),* 151-172.

SKAMP, K. (1991). Primary Science and technology: How confidents are teachers? *Research in Science Education, 21,* 290-299.

TACQ, J. (1997). *Multivariate analysis techniques in social science research. From the problem to analysis.* London: Sage Publications.

TSATSARONI, A., RAVANIS, K., & FALAGA, A. (2003). Studying the recontextualisation of science in preschool classrooms: Drawing on Bernstein's insights into teaching and learning practices. *International Journal of Science and Mathematics Education, 1,* 385-417.

TSITOURIDOU, M. (1999). Concepts of Science in the early years: teachers' perceptions towards a "transformational field". *European Early Childhood Research Journal, 7(1),* 83-93.

VALANIDES, N., GRITSI, F., KAMPEZA, M., & RAVANIS, K. (2000). Changing pre-school children's conceptions of the day/night cycle. *International Journal of Early Years Education, 8(1),* 27-39.

YOYNG, B. J., & KELLONG, T. (1993). Science attitudes and preparation of pre-service elementary teachers. *Science Education, 77,* 279-291.

ZOGZA, V., & PAPAMICHAEL, Y. (2000). The development of the concept of alive by preschoolers through a cognitive conflict teaching intervention. *European Journal of Psychology of Education, 15,* 191-205.